

DELEGATION TO THE U.S.S.R.

Purpose: To determine whether it would be fruitful to develop a broad field of collaboration with the Russians in the fields of blood pumping devices and bioinstrumentation.

Dates in Russia: February 25 to March 4, 1973

Persons: Dr. Clarence Dennis, Director, DTA, NHLI; Dr. Lowell Harmison, Engineer, DTA, NHLI; Dr. Louis Rakita, Cardiologist, Cleveland Metropolitan General Hospital, and member and Acting Chairman, Advisory Committee, DTA.

Last minute changes of plans were occasioned by the strike of air control and ground personnel first at Orly and then throughout France. Dennis arrived Air France at Orly accompanied by Dr. Tetsuzo Akutsu the a.m. of February 22 and was grounded. Took "Le Mistral" train to Lyon, arriving 6 p.m. for one-day conference honoring the 100th anniversary of birth of Alexis Carrel.

February 24 out of France by train to Zurich, to where Harmison and Rakita had also switched to permit the three of us to go to Moscow together. February 24 dinner at Kronenhalle: Prof. and Mrs. Ake Senning, Rakita, Harmison and Dennis.

February 25 flew Aeroflot arriving Moscow about 4:30 p.m. where we were met by Prof. Valeriy Shumakov, Dr. Tichion Egorov, and Dr. Andrew Fenomenov (Deputy Director, Research Institute of Clinical and Experimental Surgery). We were housed in Hotel Pekin in quick time, 5th floor with elevators spasmodically operative and a generally decadent aura (tile falling off in bathrooms, one toilet seat collapsed, crudely unfinished tile work). All rooms were less than desirable quarters. We were told that to make a change would be very difficult. Our host, apparently, saw the rooms for the first time when we did.

We were taken to dinner at the Georgian Restuarant with about a dozen of Shumakov's associates; among them Dgorg Itkin, Ephraim Stengold, Aman Kasimov (physiologist), Fenomenov, Alexis Kubaev (physiologist), Victor Goryaenov, Subarev (Surgery), etc. It is hopeless to try to stay with them and their toasts. Very pleasant.

February 26, 1973. We stopped at the American Embassy and spoke with Jack Tech, Ph.D. and then rode to Department of Transplantology of the Research Institute of Clinical and Experimental Surgery and the Hospital Surgical Clinic of the I. M. Setsenov First Moscow Medical Institute. This is a 12-year-old hospital of Prof. Petrovsky's that looks like hospital architecture of 30 years ago, high ceilings, open elevators, all plastered, and clean. The group has done 182 renal transplants and did two from a cadaver today. The operative work was heavy handed and often tintured with tension, perhaps related to anomalous arteries in the kidney. We were told that the patient whose operation we watched was doing nicely when we left Moscow. We saw several patients who had lost transplants from rejection more than a year after transplant. The unit has 30 beds. The dialysis is largely Kiil, with a Russian mixer.

Shumakov now boasts that he can store kidneys in the lab 32 hours with function and survival, but he still refuses to reveal what his solution is or just how he uses it. In perfusion preservation he has pO₂ and pCO₂ probes in the line on each side of the kidney and judges viability by adequacy of O₂ use and CO₂ production.

He uses a Skinner type of cup to preserve cadaver kidneys in situ also. It has a flexible margin. Has run 18 and 21 hours successfully, no heparin. He insisted there was absolutely no myocardial trauma until it was pointed out to him on his own slides. The service has done 184 renal transplants, including the two today.

Two patients have suffered rejection two years after transplantation. Suppression appears to be handled as in U.S.A.

We saw several blood pumps via a motion picture film. They are impressed with imposition of a negative surface charge and mix carbon with the substance of the ventricular wall. They are experimenting with ball, flap, and cuspid valves. They use the Hall effect to end systole. The film showed a coarse type of dacron flocking, but also some sections showing intact tissue coverage.

Additional items on the transplant performed include total absence of any kind of sponge count and no apparent X-ray markers on sponges. The sutures were by Ethicon. The anesthesia was pentothal, curare - N2O. A very precise copy of the Engstrom respirator was marked made in CCCP with Russian labels. There was striking absence of up-to-date suction tubing, which was soft rubber and collapsable and gave continuing trouble on that account. The duration between Shumakov's entry with the wound already open and his departure with the bladder not yet closed was 2-1/2 hours (as opposed to Samuel Kountz' 60 minutes skin-to-skin).

February 26, 1973. To the Department of Medical Instrumentation of the Ministry of Medical Production. This is headed by Michail Davidovich Pekarskey. His chief of physiology is Karl Klantarov, D.Sc., who also heads the Laboratory for Nuclear Medicine. This is the main pilot institution in development of instruments. After it has completed development and set the standards, numerous production factories about the country produce the items in question for general medical use. The specifications for items to be developed are provided jointly with people from the medical schools.

They do not have T & E facilities established as such, but usually the clinics to which they deliver completed items have experimental laboratories for testing. All projects must be approved by the Minister.

It developed that in CCCP there are no ties between the medical faculties and the universities. There are men in various parts of the surgical profession on the paid staff of the Department. Usually, these men spend a portion of their working hours in clinics, where they are highly prized.

We toured the showroom, where the following items were of special interest:

1. A circulatory assist pump on the Dale-Schuster pattern which it was stated could synchronize by triggering from the Q.R.S. complex to rates up to 200/min. and flows up to 4L./min. No answers as to hemolysis.
2. A pump similar to that at Penn State capable of 6 L/min.; it was stated no vacuum in the air phase was needed at that pace. The bladder and ball valve are of unreinforced silicone rubber--type not classified. Although polyurethane was mentioned, there was no recognition of the term "segmented block polyurethanes," which have proven superior in the U.S.A.
3. There is no work on oxygenators in progress here or any place in CCCP known to the representatives we met.
4. Electrically controlled, device purported to induce sleep, using pulsed currents of lesser magnitude than for anesthesia. At 100 Hz, it provides 5 millisecond pulses. The device covers and provides pulses through both eyes and the base of the skull. In response to the question whether sleep after 15-30 minutes might be either natural or the result of suggestion, it was stated that this item was of no importance since the patient was asleep anyway.
5. A muscle stimulator was stated to be effective in some forms of atrophy and as an aid to development of athletes. It provides 20 milliampere flows at 2000 Hz by application of 20 volts and is painless.
6. An external ventricular defibrillator calibrated in volts (up to 1 KV) without mention of watts delivered.
7. A device for echo encephalography.
8. Since the Engstrom (not attributed to Engstrom) is not readily applicable for respiratory assist, a device was developed which is applicable easily to both full carriage and assistance of respiration. It appeared to be a very good machine.
9. Dr. Klantarov presented a method for use of IV injection of Xenon for determination of cerebral blood flow and cardiac output; the consistency is within 10% in a given subject, but the absolute values must first be established with I 131. He promised to send reprints when available (June).
10. There was no evidence of work on noninvasive diagnosis of arteriosclerotic changes.
11. They are exploring production of a standardized sound at 80 cycles/sec directed into the mouth for propagation down the trachea, with multiple recording microphones on the chest. They think this will be effective in recognition of degrees of fibrosis (e.g. silicosis) not recognizable on X-ray.

Leaflets were provided on many of the above.

The evening of February 26 we dined at the home of Dr. Aman Kasimov, We enjoyed an excellent pilaf.

Tuesday, February 27, 1973, was spent first in Dr. Shumakov's laboratory. Here Dr. Dgorg Itkin described development of the algorithms for an artificial heart, using data from 150 dogs. The conclusion was that Starling's law is an inadequate foundation for regulation. Dr. Guyton was cited. They expressed concern that exercise brings about changes which cannot be achieved by Starling's law, such as changes in force of contraction and cardiac output; yet all experiments were done on anesthetized dogs without electrical stimulation. They are trying to duplicate the effects of baroreceptors by means of detectors of tension on the aortic wall and computerization. The proposed method measures end-diastolic volume but not central venous pressure. They refused to outline the circuitry or the pattern of it on the thesis that the method has been submitted for patent and will not go into public domain for six months. It was conceded to Drs. Harmison and Rakita later that the difficulty is that the pattern is no further advanced than on paper and untried.

We saw artificial hearts of diverse designs and could elicit no evidence of rheologic studies in establishing design. They are using "latex" but the life is only a day; they will go to silicone rubber and hope for improvement. We saw no flocked surfaces per se; however velour-type surfaces were in use. The laboratories appeared to be equipped perhaps adequately but not superbly.

On Tuesday we spent a very pleasant hour with Prof. Petrovsky. He spent most of it outlining his hopes for the further development of medicine in CCCP, his methods of training and of retraining intensively every few (4-5) years. He personally operates 2-3 days a week. Any patient can call him anytime and he prefers to care for people from remote centers, who may have difficulty gaining care. There developed a discussion of the fate of silicone rubber ball valves. When we remarked there had been failure in about a year in some from lipid absorption, both Petrovsky and Shumakov stated firmly they had had their own silicone rubber valves in place for periods of almost 10 years and had seen no single instance of such deterioration. We did not feel competent (either the Russians or the Americans) to unravel this difference, but more discussion by biologically oriented polymer chemists might be very rewarding.

We (the three Americans, Dr. Shumakov, and the interpreter, Mrs. Maxine Modestova) returned to the lab for more talks and discussed further the binding of heparin to surfaces, crosslinking (giving Lagergren credit), pyrolytic carbon, and other items without conveying the feeling that there was real comprehension--perhaps the language barrier.

They have developed their intraaortic balloon and console--the balloon of polyurethane, which has been used with improvement but no survival, but it appears that it is now the Datascope equipment taken there by Dr. David Bregman that is set up for more clinical trials. The deaths which have occurred are of the general pattern seen in the U.S.A., e.g. ventricular rupture after several days.

The review of the labs showed a chemistry lab resembling in equipment labs such as Huntington Memorial in Boston in the early 30's.

There is a large device for perfusing kidneys at 3-4 atmospheres and low temperatures. There is also Belzer equipment.

There is an oxygenator of the pattern of Crystal-Medical Monitors-Waters with an 80 micron silastic membrane. It is equipped with Russian-made pumps of the AGA pattern (Swedish 1955).

There is an electronic console for use of changes in thermoconductivity for estimation of adequacy of the microcirculation. The facility uses entirely separate operating rooms for (1) transplantation, (2) artificial heart, and (3) assisted circulation. We were given samples of copolymers of polyurethane backed with dacron mesh--(50 u thick) used in oxygenators.

We then visited the Bakulev Institute of Cardiovascular Surgery, U.S.S.R. Academy of Medical Science. It was organized by Prof. Bakulev in 1956, now deceased. It is narrowly specialized and has both clinical and laboratory facilities. It is divided into four sections: (1) congenital heart disease, (2) acquired heart disease, (3) vascular disease, (4) diagnostic cardiology. It has 275 beds and eight operating rooms. There is a special lab for assisted circulation. The Chief, Prof. Burakovsky operates four days a week, and there are 40 operations, including 10 or 12 with cardiopulmonary by-pass, each week.

No transplants have been done here yet.

They are using a hyperbaric chamber for some operations and showed us a healthy looking girl who had had an atrial septal defect closed a week before with four minutes of ~~circulatory arrest in the chamber~~ but no cooling or perfusion. She had had failure with her ASD.

The hospital has 20 operating surgeons and 167 research workers.

They have done 40 aorto-coronary bypasses the past two years. Only those with clinical evidence of closure are being studied in detail. Those without complaints in Russia are very resistant to having angiography done for control purposes.

They use German or Swedish demand pacemakers, but have one of their own too, which they state runs 2 $\frac{1}{2}$ years before battery change. Defects in the leads appear in more than 1/4 of cases.

Here acute myocardial infarction with or without shock is never given surgical intervention, and they are just considering coronary arteriograms while giving circulatory assistance.

They can get any kind of oxygenator they want, according to Shumakov, but clinically they use some bubbler such as Travenol. (That was perplexing since his staff had shown great curiosity about the Travenol we took to them as well as about the disposable needles, syringes, and catheters.)

They use German Phillips and Swedish Elema diagnostic X-ray equipment and do ten arteriograms daily. There was a French Teko recorder in the lab.

Questions on closure of aorto-coronary shunts drew no clear answers except that 15 or 20 Soviet clinics are doing post-shunt coronary arteriograms on symptomatic patients.

(One item of note was that acute rheumatic fever continues to be a problem in the country.)

The ICU had 20 beds and respirators similar to Engstroms, and wall-mounted monitors, and piped oxygen. A patient who had had mitral and aortic repair the day before was causing little concern although her lungs sounded in need of suction and her Engstrom-like respirator was running at +40 and -20 cm. of water. She was not responsive.

Some patterns of aortic repair for Marfan's disease were presented by Prof. Burakovsky with a pattern of reconstruction very successful in 12 of 16 cases.

A second ICU was equally impressive, for infants. Tetralogy appeared to be reasonably handled. Some questions as to wise procedure in a young adult with ~~a~~ large VSD, systemic pressure in the pulmonary artery, and 5-1/2 liter L-R shunt indicated the responses of this group to be similar to those of Dr. Rakita.

Two hours in a Russian sauna bath made an experience, but the reactions of the visitors were varied.

On Wednesday, February 28, the group visited the A.V. Vishnevsky Institute. Prof. A. A. Vishnevsky spent only a few minutes with us; he looked frail and ill compared to former meetings with him by one of us (CD). A stubborn viral pneumonitis was given as the cause of loss of over one month. Dr. K. Charnas guided the group.

Three films were shown in a beautiful theater the seats of which stirred up one case of back pain. The first concerned a computerized program to aid in diagnosis of distant problem cases, similar in many respects to that under study at Duke. A second concerned electrical stimulation of the intestine as an aid to diagnosis. The third concerned Vishnevsky's work on stimulation of the bladder in paraplegics.

This latter area is in a special spinal department of 25 beds, shortly to be enlarged to 60 beds. It is run largely by B.A. Kolpachkov and V. N. Bielyaev.

Here much work has been done on stimulation of the bladder, with definite progress of the state two years ago when one of us visited. The current is 15-20 Herz, 10-16 volts, of square wave pattern, in 3-5 second bursts over 5 minutes three times daily. Six electrodes are placed on the bladder at operation, and a buried ~~secondary coil with enclosed electronic~~

Circuitry permits complete implantation--coverage was silicone rubber. The external component is battery powered and operated by the patient. Patients have been carried up to 10 years with this technique with clear urine. A three-times-daily pattern achieves conditioning so the external unit can at times not be needed. The success of the method is attested by the expected enlargement of the unit. Cryosurgical enlargement of the bladder neck is often utilized.

The building is 2-1/2 years old, with 12 huge, high-ceilinged operating rooms, 550 beds, and immaculate appearance. There are no students here, and the hospital is entirely surgical. There are 200 physicians, 1000 total staff. Corridor and room ceilings are at least 10 feet high (Petrovsky's 12 feet).

The ICU uses TV cameras, as in Stockholm, to permit visual contact at the nursing station. Infrared light is used at night to permit observation in the dark.

In the midst of all this, the suction tubing for tracheal aspiration was of apparently ancient rubber. The ICU had an integrated EEG to permit quick determination of depth of anesthesia.

A resuscitation room is maintained with equipment sterile and ready, including a cardiopulmonary bypass unit, a respirator, an anesthesia unit, and a cardiac cup massager (Skinner).

A dialysis unit uses Kill dialyzers with cuprophane.

A Xenon monitor has six leads for lung and/or brain. Evans blue is used first to establish the level. They do not yet have cardiogreen. A teletype unit tied to a computer elsewhere in the hospital was used to determine O₂ saturation, bicarbonate, etc. from pO₂ and pH here. An ancient Cambridge recorder is used for cardiac output.

There was an intraaortic balloon with a console also, but no one knew the thickness of the balloon or the characteristics of the pulse. There was no oxygenator in sight, and presumably the cardio assist device was to be used for counter-pulsation.

It developed in discussion that Shumakov has used cardiopulmonary bypass for the shock of extensive burns a half-dozen times, but without salvage.

Repair of tetralogy of Fallot in young patients is still usually (nearly always) done in two stages here. There have been 800 Blalock-Vishnevsky shunts in infants, and thus far definitive repair has been done in 120. (Two years ago one of us and Dr. Wm. Glenn saw the end of a Blalock shunt operation in a boy who appeared to be 8 or 9 years old.)

Discussion at lunch revealed there are not yet data on patients treated with the intra-aortic balloon. It is planned to use it post-operatively for needed support after valve replacements. They do not admit patients with acute myocardial infarction here and have to take equipment and proceed

to other hospitals to employ it for this indication. The maximum rate is 120/min. They use CO₂ and the ratio of systole/diastole varies from 1/3 to 1/2. The number of milliseconds required to inflate the Russian balloon was not known. They denied aortic wall damage if the inflated balloon is smaller than the lumen.

Wednesday, February 28, p.m. We visited the Research Institute of Surgical Instruments and Devices, Ministry of Health. The Head is called Head of All-Union Scientific Research Institute for Medical Engineering, Rustam I. Utjamishev. He was assisted by G. Kochetov, Chief of the International Cooperation Department. We were told the aim of the Institute is to develop medical technology and that 18 U.S.A. firms had sent representatives to visit. It is in charge of medical technology "for all socialist countries." The experimental plant is in Moscow. It is this group which developed the surgical stapling units which have been widely adopted. We were given a beautiful demonstration of surgical stapling of a 1.5 mm. ring suitable for coronary anastomosis (cost ea. \$1000.00). They make special instruments for cardiac surgery, transistor-tipped catheters, etc.--but nothing really new. Extracorporeal circulation units have first been patterned and made here and then distributed for manufacture elsewhere. Dialysis equipment for Shumakov is made here. (Catalog to come.) There are animal labs here, but some animal work is also done outside. The hyperbaric units also were made here.

They are not especially concerned with blood interfaces and are using "polyurethane" but not the segmented block polymer.

They were not yet ready to show their computer center.

This Institute sets standards for medical devices for U.S.S.R. and is participating in the current international discussions on setting of standards (Technical Advisory Group is a U.S. component). There was elegant monitoring for use in hyperbaric chambers.

Wednesday, February 28, 1973, we were taken to the Bolshoi Theater to see the Ballet Anna Karenina--a superb structure with a performance to match. The ballerina was Maya Plyetskaya. There were beautiful portraited ceilings and many tiers of gilded arcs of boxes. (Dr. Hegyeli also attended)

After the ballet, the three of us, Shumakov and his chief man in charge of artificial heart work, Dr. Tichyan Egorov, boarded the Red Arrow Express for the overnight ride to Leningrad (Krasnaya Strela Express). The 2-berth bedrooms were superb and the ride second only to Le Mistral in France, but the toilet facilities flooded and became impossible.

Thursday, March 1, we were installed in the Hotel Leningrad upon arrival--a very modern and elegant hotel. Then on to visit the Pulmonology Institute. The chief of the Laboratory of Experimental Surgery, Professor Georgy A. Rusanov, and the Chief of the Division of Organization of Scientific Research, Dr. Lydia P. Volkova, and their staffs welcomed us. The Institute is working on transplantation of heart and lungs, circulatory assist devices, and artificial hearts.

They have run left ventricular bypass three weeks in the dog, carrying 60% of the total output and decreasing the left ventricular pressure. They have run IAB's ten weeks, with occasional heparinization. The balloon is of polyvinyl chloride coated with bonded heparin. They developed their own unit, which appears to have little discriminatory refinement to sense the QRS complex. Maximum follow rate is 110/min.

Clinically they have used extracorporeal circulation for combined renal and cardiac failure. Two of ten patients were salvaged and went home. In all ten heart failure had been considered too severe for dialysis without pumping.

They are using butterfly valves of dacron and silastic. The respiratory equipment appeared obsolete.

The ICU had parsimonious equipment. A boy five days after correction of pentology of Fallot had a gangrenous right hand attributed to a "mistake."

No one here was working on non-invasive measurement of pO_2 , but they said this is being done in Novosibirsk.

There is an active dog lab program in preservation of the lung at 30C (after wash out with salt solution plus calcium ion and a protein) and slow ventilation without perfusion. They were aware of the work of A. Garzon but dismissed his much better performance on autotransplantation after a day of storage as being "no good."

At this hospital work is done on cardiovascular and pulmonary surgery, but no coronary work is being performed.

We had lunch with the group in the Director's Office. It was stated their pacemakers run 3 1/2 years before replacement and that 25% of the leads fail.

Apparently only at Shumakov's is there thought of using nuclear power.

The hospital has 280 beds and does 15 heart operations/week. It is about a decade old but parts appear decadent. Upkeep seems to be a problem.

Thursday evening Dr. Volkova took the 5 of us to the Leningrad Opera House to see the Ballet Sleeping Beauty. The performance and the house matched those at Moscow. Dr. Volkova is a delightfully commanding person, apparently known to all. We sat in the Director's Office (Peter Rachenskiy) for ice cream between acts, and met him. We were taken backstage to meet the leading ballerina in a later interval. She was Erena Kolpakova, a surprisingly tiny and very delightful person--about 5 feet and 90 pounds est. (It was pleasing to recollect having given Dr. Volkova a box of Zurich chocolates at the beginning of the evening.)

Friday, March 2 - We visited Professor V. I. Kolesov's clinic of The First Leningrad Medical Institute. He and his surgeon son spoke English rather well and proved delightful hosts at the hospital and that evening for dinner at the hotel. Professor Kolesov has 130 beds and is interested in coronary surgery, having done an internal mammary anastomosis in 1964. (J. Thorac. and C.V. Surg., Oct., 1967 - 20 cases). They use a stapler capable of anastomosing end-to-end arteries 1.3 mm in diameter. The method is not good for the circumflex, but where the coronary can be divided and staple anastomosed he believes the situation sounder and the patency surer than after end-to-side. Usually with the stapler extracorporeal circulation is not needed (Dr. Rakita noted Dr. Ankeny also does without extracorporeal circulation.)

In getting started in 1964, Professor Kolesov had a "battle of wills" with the cardiologists, who opposed any surgical approach. Yet 9 of the original 12 patients are living and well. He also has difficulty gaining the consent of patients for post-shunt angiograms. For this latter reason they are working on a 111-lead electrocardiogram and feel it is almost as valuable in determining areas of ischemia as the arteriograms would be. Unfortunately, there are not enough control angiographic observations for conclusions. For extracorporeal circulation they use the Russian made Kay-Cross type of equipment. Staplers simplified the procedure in 1967. About 10% of patients have "unsatisfactory results." They claim 94% agreement of the 111 lead electrocardiogram with angios on the LADC and 87% on the RCA.

They have not used vector electrocardiograms.

They have lost one patient on angio out of 210 performed, due to acute myocardial infarction. Also, performance of angio shows on 111-lead electrocardiogram areas of ischemia which persist for a week.

They have done no enzyme studies.

The stapler is superb, but much else is antiquated.

After coronary anastomosis they keep patients in hospital one month. Return to work thereafter is from ten days to two months depending on the exertion required on the job.

ICU is a huge area with two monitors - very little equipment.

The operating rooms have glassed observation domes at least 20 feet above the patient and no detail can be seen.

The hospital has 160 beds total and 6 operating rooms.

The diagnostic X-Ray is Siemens.

Review of the III-lead electrocardiograms was impressive, but it was not clear how it could separate multiple vessel disease. Difficulty was freely conceded in posterior wall disease.

In the afternoon we toured the Hermitage with our Leningrad interpreter and Dr. Volkova.

Dr. Volkova is most impressive and will be visiting NCI in October. It will be a challenge to reciprocate.

After dinner at the Leningrad Hotel with the Kolesovs, and Dr. N.G. Volodkovich (a friend of Dr. Morrow) we returned to Moscow overnight on the Red Arrow.

Saturday, March 3. We returned to the Research Institute of Clinical and Experimental Surgery to see Dr. V. I. Petrov and to learn about the ultrasonic, bloodless bone cutter. It was demonstrated only on some segments of dried bone. Shumakov says it is bloodless if used in splitting the sternum. It is also used in "welding" bone with fine bone powder and cyanoacrylate, but it was not clear how the ultrasonic knife helped. Still uses ties to close sternum.

The device is used to flatten calcified arterial plaques, in this instance as a tight-fitting sound. No pieces break off, and washing out emboli is unnecessary. The device can pass 30-40 cm. For the coronaries he and Petrovsky are working on one that will be flexible and can reach the coronaries from the groin.

In trauma work, the "bone welding" is employed around the elbow, small joints, humerus, and ankle. Immobilization is still needed to some extent.

In the afternoon the Shumakov family took us to the Circus. This is largely acrobatics (superb) and clowning (good). The only animals were horses, camels, and bears. They use a net for safety in the trapeze act, which proved fortunate.

We had dinner at the home of Dr. and Mrs. Vsevolod Subarev - 14 in all - with far more toasting than was good even for our hosts, leaving a bundle of gifts for distribution.

Impressions, professional:

1. Old style surgery
2. Not up on polymers
3. Not well instrumented
4. Not incisive in investigational thinking, (e.g. III lead ECG and Electronic Sleep Induction)
5. Touchy about possibly not being first (e.g. own makes of machines of others without acknowledgement)
6. Well-justified pride in what they have done, (e.g. the stapler)
7. Secretiveness (e.g. renal preservation, control circuitry)

8. Hard drinkers
9. Appreciation of art and theater
10. Cordiality

Impressions, general

1. Streets--rough, but immaculate and orderly
2. Buildings--often deteriorated and showing poor upkeep
3. Suspicion of foreigners on the part of nonprofessionals, e.g. baggage searches.
4. General friendliness

Conclusion

From a scientific point of view the gain from cooperation can be debated. We were not given time to present any of our material. They did not show us anything--not really ready except pump models. Shumakov was said to be working on Plutonium-238, and we saw and heard nothing of it. We had to insist to see the developmental laboratories in the Ministry of Medical Instrumentation, and here it is possible they were embarrassed. Shumakov's pumps are eight or nine years behind the state-of-the-art here. The thinking is often not incisive.

There is almost surely more of value than we were able to examine.

A broader, much broader, knowledge of Russian would help, and this is a formidable obstacle.

Recommendations:

Continue exchanges until we are successful in exploring more fully the whole field in more depth with a U.S. knowledgeable interpreter in the prospect of learning more about many areas, for example:

- a. Absence of deterioration of silastic balls in valves
- b. Touted exploration of nuclear energy for power